Forest Health Protection

Report 04-8 March 2004

PROTECTING WHITEBARK PINE TREES FROM MOUNTAIN PINE BEETLE ATTACK USING VERBENONE

Sandy Kegley[1] and Ken Gibson[2]

Abstract

Efficacy of verbenone in protecting individual whitebark pine trees from mountain pine beetle attack was tested for a second year. Standard 5-gram verbenone pouches, replaced at mid-season, were tested along with new thicker membrane (longer lasting) pouches and untreated controls. Treating individual whitebark pine trees with either two standard or two thicker membrane pouches significantly reduced mountain pine beetle attacks compared to untreated controls. This test provides additional evidence that individual pine trees can be protected from mountain pine beetle attack using verbenone.

Introduction

Verbenone, (4,5,5-trimethylbicyclo [3.1.1] hept-3-en-2-one), a known anti-aggregation pheromone of mountain pine beetle (MPB), *Dendroctonus ponderosae*, has been tested in the past with inconsistent results in protecting lodgepole and ponderosa pine stands (Amman and others 1991, Amman and Lindgren 1995, Bentz and others 1989, Gibson and others 1991, Shore and others 1991). Recently, a 5-gram "pouch" formulation, releasing 10 times as much verbenone as past releasers has been tested in lodgepole, whitebark, and ponderosa pine stands with promising results (Bentz and others 2004, Borden and others 2003, Progar 2003, Kegley and others 2003, Gibson and Kegley 2004).

Our observations during previous tests of the 5-gram pouch in whitebark pine stands discovered new MPB attacks in treated areas late in the season. The verbenone pouch label indicates a lifespan of 25-40 days, weather dependent. This led us to believe that the standard pouch may not be eluting verbenone throughout the entire MPB flight period, especially during years of extended above-normal temperatures. Because of this potential problem, we have replaced pouches in mid-summer to ensure tree protection throughout the season. Our objective for this study was to compare the effectiveness of a "new" thicker membrane (3 ml) pouch, formulated to elute verbenone over a longer time period, with the standard pouch (1.5 ml), replaced at mid-season.

[1]Forest Health Protection, Coeur d'Alene Field Office
[2]Forest Health Protection, Missoula Field Office

Methods

The test was conducted near Morrell Peak, Seeley Lake Ranger District, Lolo National Forest, Montana in an area with an active MPB population (fig. 1). Our treatments were (1) control, no verbenone; (2) two standard verbenone pouches per tree, replaced in late July; and 3) 2 new (slow-release) pouches per tree, not replaced. There were approximately 50 trees in each treatment and treated trees were at least 130 feet apart. Verbenone pouches were stapled to whitebark pine trees as high as we could reach on the east and west sides of each tree. In addition to verbenone pouches, a MPB-attractant pheromone (tree bait) was placed approximately 10-15 feet from each treated tree to assure equal beetle pressure.

Additional verbenone pouches were placed on site, stapled to the north side of a tree, collected at 2-week intervals, and placed in plastic bags in a freezer. At the end of the test, they were sent to Phero Tech, Inc. for analysis of verbenone content and actual release rate in the field.

Statistical Analysis

Numbers of trees with no beetle attack, pitchouts, strip attack, and mass attack were summarized by treatment. The Pearson Chi-square test was used to test for significant differences in the type of MPB attack between treatments. Because we have found a relationship between tree diameters (d.b.h.) and MPB attack in whitebark pine (Kegley and others 2003 & 2004), analysis of variance F test was used to test for significant differences in tree d.b.h. between treatments.

Figure 1. Verbenone test site near Morrell Peak.

Results and Discussion

As in the Selkirk Mountain test in 2002 (Kegley and others 2003), verbenone successfully protected whitebark pines from MPB on Morrell Peak. There were significantly more control trees mass attacked than in either of the verbenone treatments ($p<.000$) (fig.2). There was no significant difference between the standard and new pouches for mass attacks, pitchouts, or strip attacks. However, there were twice as many pitchouts or strip attacks on trees treated with the new pouch as there were with the standard pouch (table 1).

Figure 2. MPB attack by treatment on Morrell Peak.

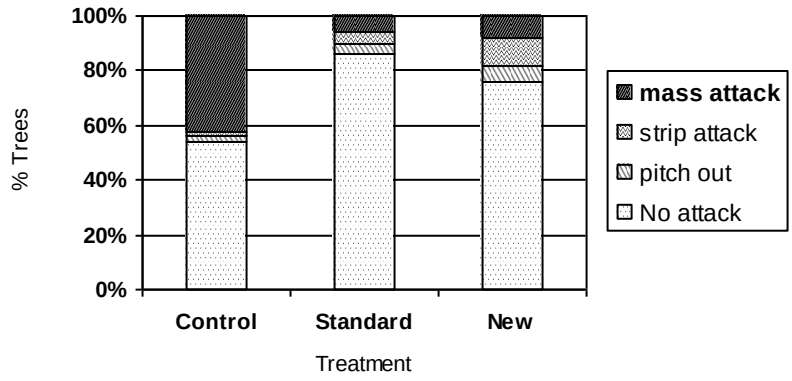

Table 1. Mass attacks, strip attacks, and pitchouts by treatment

MPB category	Treatment		
	Control	Standard Pouch	New Pouch
Ave. d.b.h.	13.9	14.9	14.6
No attack	26 (54%)	41 (85%)	37 (76%)
Any attack	22 (46%)	7 (15%)	12 (25%)
Pitch out	1 (2%)	2 (4%)	3 (6%)
Strip attack	1 (2%)	2 (4%)	5 (10%)
Mass attack	20 (42%)	3 (6%)	4 (8%)
Total	48	48	49

Average d.b.h. of all whitebark pines in this test was 14.5 inches. There were no significant differences in average d.b.h. of trees in any treatment (p=.223) (table 1).

Pouch analysis showed differences in residual verbenone and elution rates between the two pouches (John Borden, Phero Tech, personal communication) (table 2). The standard pouch released a higher amount of verbenone per day, but had a shorter elution period than the new pouch. It appeared the standard pouch stopped releasing verbenone sometime around August 18. MPB flight period in whitebark pine stands has been found to extend well into September (Kegley and others 2004). This pouch analysis helped validate the need to replace standard pouches mid-season. The low elution rate of the new pouch at higher elevations may not be sufficient to protect trees (John Borden, Phero Tech, personal communication). Higher elution rates for the new pouch were found in low-elevation ponderosa pine stands, likely due to temperature differences (Gibson & Kegley 2004).

Table 2. Elution rate and residual verbenone for standard and new pouch at Morrell Peak, June 11- Sept. 11, 2003 (data from PheroTech, Inc.)

Date (placed June 11, 2003)	Residual Verbenone (gms)		Elution rate (mg/day)	
	Standard Pouch	New Pouch	Standard Pouch	New Pouch
23 June	4.46	4.6	16	4
7 July	4.07	4.46	28	10
21 July	3.82	4.29	18	12
5 August	3.16	4.16	44	10
18 August	2.7	3.85	35	24
11 September	2.85	3.79	0*	3

*pouch had ceased eluting verbenone sometime around August 18

Conclusion

Verbenone pouches have shown great promise in protecting whitebark pines from MPB attack, even when using tree baits to attract beetles. Operationally, tree baits would not be used and, it seems logical to conclude, attacks on treated trees would be even less. This treatment would be especially useful in protecting high-value, blister-rust-resistant whitebark pine. To date, the use of two standard, 5-gram verbenone pouches per tree, replaced mid-season, has shown the most consistent results in protecting individual whitebark pines.

Acknowledgements

We thank John Schwandt, Gary Kempton, Tim Cudmore, and Sandi Bousquit for assistance in locating and treating test trees, and data collection. Michael Marsden conducted the statistical analysis.

Literature Cited

Amman, G.D.; Thier, R.W.; Weatherby, J.C.; Rasmussen, L.A.; Munson, A.S. 1991. Optimum dosage of verbenone to reduce infestation of mountain pine beetle in lodgepole pine stands of central Idaho. Research Paper INT-446. Ogden, UT: USDA Forest Service, Intermountain Forest and Range Experiment Station. 5p.

Amman, G.D.; Lindgren, B.S. 1995. Semiochemicals for management of mountain pine beetle: status of research and application. In: Salom and Hobson (eds.), Application of semiochemicals for management of bark beetle infestations- Proceedings of an informal conference. Gen. Tech. Report. INT-GTR-381. Ogden, UT: USDA Forest Service, Intermountain Forest and Range Experiment Station. p 14-22.

Bentz, B.J.; Lister, C.K.; Schmid, J.M.; Mata, S.A.; Rasmussen, L.A.; Haneman, D. 1989. Does verbenone reduce mountain pine beetle attacks in susceptible stands of ponderosae pine. Research Note RM-495. Ft. Collins,CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 4p.

Bentz, B.J.; Kegley, S.J.; Gibson, K.E., Thier, R. 2004. A test of nonhost tree volatiles and verbenone for reducing the number of mountain pine beetle-attacked trees. In preparation.

Borden, John. Personal communication. PheroTech, Inc. 7572 Progress Way, Delta, B.C., Canada V4G1E9.

Borden, J.H., Chong, L.J., Earle, T.J., Huber, D.P.W. 2003. Protection of lodgepole pine from attack by the mountain pine beetle, Dendroctonus ponderosae (Coleoptera: Scolytidae) using high doses of verbenone in combination with nonhost bark volatiles. The Forestry Chronicle 79(3): 685-691.

Gibson, K.E; Schmitz, R.F.; Amman, G.D.; Oakes, R.D. 1991. Mountain pine beetle response to different verbenone dosages in pine stands of western Montana. Research Paper INT-444. Odgen, UT: USDA Forest Service, Intermountain Forest and Range Experiment Station. 11p.

Gibson, K.E., Kegley, S.J. 2004. Testing the efficacy of verbenone in reducing the number of mountain pine beetle-attacked trees in second-growth ponderosa pine. FHP Rpt. 04-7, USDA Forest Service, Forest Health Protection, Northern Region. 10 p.

Kegley, S.J., Gibson, K.E., Schwandt, J., Marsden, M. 2003. A test of verbenone to protect individual whitebark pine from mountain pine beetle attack. FHP Rpt. 03-9, USDA Forest Service, Forest Health Protection, Northern Region, 6 p.

Kegley, S.; Schwandt, J., Gibson, K. 2004. Forest health assessment of whitebark pine in selected stands in the Selkirk Moutnains of northern Idaho 2001. FHP Rpt. 04-5, USDA Forest Service, Forest Health Protection, Northern Region, 8 p.

Progar, R.A. 2003. Verbenone reduces mountain pine beetle attack in lodgepole pine. Western Journal of Applied Forestry 18 (4) 229-232.

Shore, T.L.; Safranyik, L., Lindgren, B.S.. 1991. The response of mountain pine beetle (*Dendroctonus ponderosae*) to lodgepole pine trees baited with verbenone and *exo*-brevicomin, Journal of Chemical Ecology 18(4):533-541.